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NATIONAL DAM SAFETY PROGRAM. MUNSON DAM (NJ00118), DELAWARE RIV--ETC(U)
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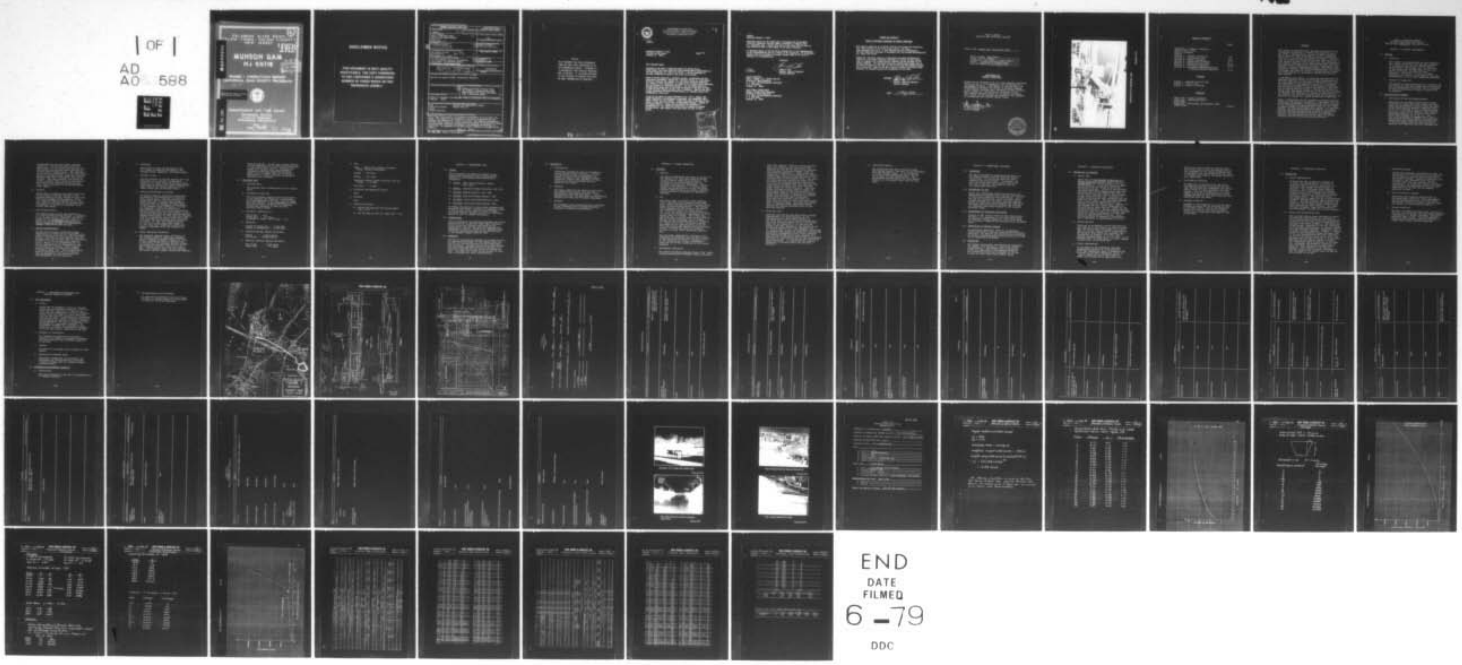

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DELAWARE RIVER BASIN
SALEM CREEK, SALEM COUNTY
NEW JERSEY

LEVEL II

MUNSON DAM
NJ 00118

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

410 891

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

May 1979

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National Dam Safety Program
Munson Dam
Salem County, N.J.

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7. AUTHOR(s): F. Keith Jolls, P.E.

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Louis Berger & Assoc.
100 Halstead St.
East Orange, N.J. 07019

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Dams
Structural Analysis
Safety
Visual Inspection
National Dam Inspection Act Report
Munson, Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

2 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Munson Dam in Salem County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Munson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. Based on the dam's overall condition and hazard classification, no remedial actions are recommended at this time.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman William J. Hughes of the Second District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-D
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

MUNSON DAM (NJ00118)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 10 January 1979 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Munson Dam, initially listed as a high hazard potential structure but reduced to a low hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. The low hazard potential classification means that in the event of failure of the dam, no loss of life and only minimal economic loss is expected. Based on the dam's overall condition and hazard classification, no remedial actions are recommended at this time.

APPROVED: James G. Tom

JAMES G. TOM
Colonel, Corps of Engineers
District Engineer

DATE: 2 May 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

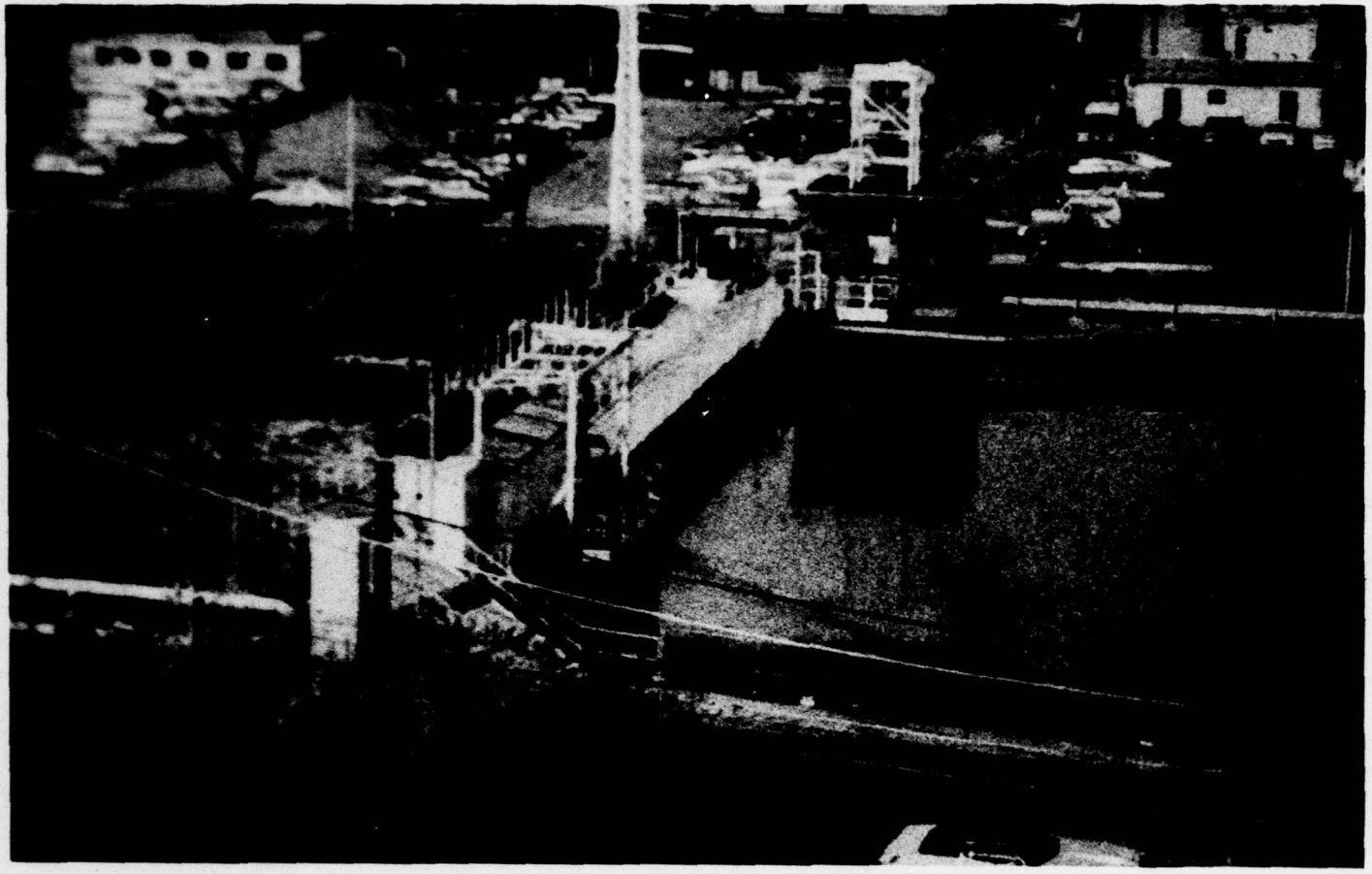
Name of Dam Munson Dam Fed ID# NJ 00118

State Located New Jersey
County Located Salem
Coordinates Lat. 3938.7 - Long. 7530.4
Stream Salem River (Salem Canal)
Date of Inspection 10 January 1979

ASSESSMENT OF GENERAL CONDITIONS

Munson Dam is assessed to be in a good overall structural condition and it is recommended to be downgraded to a low hazard category. Overtopping of the dam would not significantly increase the danger of property damage. No detrimental findings were uncovered to merit further study, either of a structural or hydraulic nature. The combined spillway capacities of Munson and Brown Dams (which jointly impound the reservoir) are adequate to accommodate the 100-year design flood.

F. Keith Jolls P.E.
Project Manager



OVERVIEW OF MUNSON DAM

JANUARY 1979

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FIGURES

APPENDIX

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: MUNSON DAM FED ID# NJ 00118

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Munson Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Munson Dam is a straight tidal-control gated structure 195 feet wide built across the Salem Canal and is formed by a steel H-pile and sheet piling double-walled cellular cofferdam driven to El. -19. The top of the 17' wide structure is at El. +12.5 with a central 66 foot section containing twelve 4'x4' vertical lift sluice gates whose inverts are at El. +2. The top of the cofferdam is capped with a steel and concrete structural system of access walks, ramps and working platforms for the operation of the lift gates, three of which are motor-operated (the remaining nine are equipped with

floorstands for auxiliary power equipment operation). The 66 foot gate section is faced with a 12-inch reinforced concrete wall and contains an inclined trash rack over an 18-inch thick concrete apron. The remainder of the cellular cofferdam is filled with earth. There are in-take houses, pumps and steamline plumbing facilities situated at each end of the dam. This dam, together with Brown Dam which is located some 2 miles to the east on the Salem River, comprise the Dupont salt-water tidal protection for their freshwater plant supply.

b. Location

Munson Dam is located on the Salem Canal just to the north of the east abutment of the Delaware Memorial Bridge (Routes 40 and I-295) within the Chambers Works property of the E.I. Dupont de Nemours Company and is 1,000 feet from the east bank of the Delaware River at Deepwater in Pennsville Township, Salem County, New Jersey.

c. Size Classification

The maximum height of the dam structure is 31.5 feet and the maximum storage is estimated to be 19,460 acre-ft. Therefore, the dam is placed in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams (storage capacity between 1,000 and 50,000 acre-feet).

d. Hazard Classification

The dam was initially classified as high hazard but as a result of the inspection, its crest elevation in relation to the surrounding terrain, its position just upstream from the Delaware River and the fact that all downstream terrain is on the enclosed plant property of E.I. Dupont, it is recommended that its hazard classification be downgraded to low. In the event of a failure, little damage would be inflicted on downstream property or endanger human life. This classification makes no cognizance of the vital function the dam performs for the plant operation (see paragraph h of this section).

e. Ownership

Munson Dam is owned and operated by the E.I. Dupont de Nemours and Company, Inc. Chambers Works, Deepwater, New Jersey 08023.

f. Purpose of Dam

The dual purpose of the dam together with the Brown Dam, is to provide a fresh water reservoir for power house and chemical plant supply and to prevent salt water contamination from entering the supply reservoir due to tidal inflow from the Delaware River.

g. Design and Construction History

The present dam was originally constructed by duPont in 1934 adjacent to an existing water intake house. The dam was built in conjunction with the Brown Dam (roughly 2 miles upstream) to prevent brackish water intrusion into the freshwater intake supply of the Chambers Works powerhouse. The dam has undergone a series of structural modifications since its initial construction, the most recent being the installation of the three power-operated and nine manually-operated Chapman sluice gates (in 1956) and the installation of an electrical alarm system with tidal limit switches and recording tide indicators (in 1958). In 1952, the walkway sections on each side of the gates were raised to El. +12.5 by steel flashboards welded onto channel kickplates along the access platforms.

h. Normal Operating Procedures

The extensive chemical plant facilities of the Chambers Works is completely dependent upon an adequate freshwater supply for their in-plant powerhouse which is located just to the south of the Delaware Memorial Bridge. The supply must be kept free of salt so the dam's primary function is that of a tidal gate. The reservoir above the dam impounds the plant's overall supply (along with numerous

injection wells). An adequate storage capacity must be maintained as the plant must close down if the reserve gets too low. The gates are manned on a 24-hour basis and adjusted as required to maintain prescribed reservoir levels (+4.8 in summer and +4.3 in winter). Additionally, a small mandatory discharge is required to be released.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of Munson Dam is 60.0 square miles.

b. Discharge of Dam Site

The total gateway capacity with the reservoir at the abutment top elevation is calculated to be approximately 2,030 cfs. This is based upon the condition of the flashboards at Brown Dam being closed. No definitive discharge records are available at this site for upstream record floods.

c. Elevation (Above M.S.L.)

Top of dam - 12.5
Normal pool - 4.8 (max.)
Streambed at center line of dam - 4±

d. Reservoir

Length of normal pool - 5,000 feet
Length of maximum pool - 38,000 feet

e. Combined Storage (Munson and Brown)

Normal - 1,100 acre-ft.
Top of dam - 19,460 acre-ft.

f. Reservoir Surface (Munson and Brown)

Top of dam - 4,149 acres
Normal pool - 171 acres

g. Dam

Type - Gated tidal control structure (steel cellular cofferdam).

Length - 195 feet

Height - 31.5 feet

Freeboard between normal reservoir and top of dam - 7.7 feet

Top width - 17 feet

h. Diversion and Regulating Tunnel

None

i. Spillway

None

j. Regulating Outlets

1) Twelve 4x4 vertical lift sluice gates (Inv. +2.0)

2) One 4x4 gate on 48" C.I. Pipe (Inv. -4.5)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information available for review of the Munson Dam consisted of the following design drawings of the Chambers Works Engineering Department:

1) W22535: Sheet piling details, dated May, 1933.

2) W22550: Concrete Gateway Structure, May 1933.

3) DW 5732: Walkway Details, Nov. 1945

4) DW 8261: Ramp and Walkway Repairs, 1952

5) DW 10927: Sluice Gate Modifications, 1956

6) DW 12391: Electrical Alarm System, 1958

No design computations or structural analyses were available for review. Further, an extensive search of the records of the State Division of Water Resources revealed nothing on file of a technical nature to aid in a design evaluation.

2.2 CONSTRUCTION

Little information was obtained regarding the actual construction as no as-built plans were available. From the various revisions indicated on the design plans, the initial work was substantially completed in 1933-34. There are no apparent major structural modifications except the installation of new Chapman Company gates in 1956.

2.3 OPERATION

The dam is continuously operated as a gated facility by engineering personnel of the Chamber Works who control the outflow and maintain the established pool elevation. Releases are normally made through the three power-operated sluices to maintain the reservoir elevation and the statutory minimum outfall. The gates are closed during periods of high tide to exclude salt water contamination.

2.4 EVALUATION

a. Availability

Sufficient engineering data is available to assess the structural stability. No data was available to base an assessment of safety in regard to the embankment zones immediately behind each abutment but these areas are of minor importance and are thought to be stable.

b. Adequacy

The field inspection and review of the available design plans reveal that the dam is structurally sound and well-built. It is believed that the available data is sufficiently adequate to render the following assessment.

c. Validity

The validity of the engineering data available is not challenged and is accepted without recourse to further investigations.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspections were held on January 10 and February 22, 1979 and revealed the dam in satisfactory operational condition. All elements are in true alignment with no noticeable differential settlement. Due to internal plant security, no close-up photographs were permitted but as only the upper platform superstructure is visible, this had little bearing on the degree of inspection afforded.

b. Dam

The double rows of cellular steel sheeting piling, hardware and structural steel walkways, support systems and railings show little signs of serious deterioration. The Larrsen steel sheeting and 10B4 piles at the intake lip immediately behind the gate inverts (El. +2.0) are driven to a minimum elevation of -19 and are connected transversely at 6'-6" centers with 1½" tierods. The 5-foot wide spillover area is filled with concrete ballast and an 18-inch reinforced slab is poured between the main cofferdam walls at elevation +2. There are 12-inch reinforced concrete buttresses at the quarter-points of the 66-foot wide sluice gate opening and the vertical barrier (to which the gates are mounted) is also a 12 inch thick reinforced concrete wall.

The only major modification (insofar as the inspection is concerned) was the 1952 raising of the effective dam crest to elevation 12.5 by the installation of steel flashboards along the top of the kickplates on the access walkways.

c. Appurtenant Structures

The twelve sluiceway openings contain 4'x4' steel flanged bronze-mounted Chapman rising stem gates

with floor stands. Three are motor-operated while the remaining nine are fitted with adaptors so they can be electrically operated with portable motorized equipment (such as pipe-threading machines). These gates were installed in 1956 as a replacement for earlier flapper-type gates which were mounted on the upstream side of the concrete wall. The gates are protected from freezing by steam lines. The three electrically-operated gates on the north end are equipped with limit switches and alarms which are wired back into the plant power office and filter building. The alarm system includes exterior warning lights and horns which sound if the tide elevation or established reservoir elevations are exceeded. Dupont also maintains a continuous recording device which records water elevations. Nine foot high inclined trash racks are positioned in front of the sluice gate section over its entire length. The racks are braced with a transverse steel beam which frames between the concrete buttress walls in the spillway opening.

d. Reservoir Area

Upstream from the dam the Salem Canal extends approximately 1.8 miles easterly to its intersection with the natural channel of the Salem River (in the vicinity of Brown Dam). The canal averages between 150 and 200 feet in width and is crossed by 1) an old railroad bridge 3,000 feet upstream 2) the Routes 49 and 130 bridge leading north into Deepwater and 3) three bridges of the I-295-Turnpike interchange. All bridges have sufficient hydraulic capacity and headroom to accommodate normal floods although the railroad bridge could prove somewhat of a constriction if blocked by debris (see photographs). The canal is clear of flotsam and has relatively steep sideslopes. In some areas the existing embankment is slightly below the dam crest elevation.

e. Downstream Channel

The canal below the dam is slightly wider and extends roughly 1,000 feet to its confluence with the Delaware River. It is crossed by a utility bridge immediately below the dam but is free of other obstructions. The surrounding terrain beyond the canal embankments is at or slightly lower than the dam crest.

SECTION 4 - OPERATIONAL PROCEDURE

4.1 PROCEDURES

The dam is operated by engineering personnel of the Chambers Works staff who maintain 24-hour surveillance of the sluice gates and tidal recording and alarm devices. In general, the canal is purged twice daily during periods of low tide to maintain the reservoir pool at its established elevation.

4.2 MAINTENANCE OF DAM

Dupont has promulgated exhaustive operating and maintenance proccedures and in effect, has continual 24 hour-a-day inspection and maintenance. Due to the type of construction, there is little actual up-keep required for the steel cofferdam system except for when major modifications are undertaken. The upper portions such as walkways and railings are carefully maintained because of the constant personnel usage.

4.3 MAINTENANCE OF OPERATING FACILITIES

Because of the crucial nature of the tidal control operation, all equipment is vigilantly maintained in excellent working condition. The sluice gates are constantly inspected and repaired on an as-needed basis.

4.4 DESCRIPTION OF WARNING SYSTEM

As previously described, there is an elaborate electric/mechanical warning alarm system continually activated. All devices are monitored and reinforced by Dupont's emergency system during periods of flooding or operational breakdown.

4.5 EVALUATION

The present operational and maintenance procedures are deemed to be adequate in view of the hazard classification. The Chamber Works engineering staff have experienced, well-managed personnel who diligently pursue the management of the dam as part of their fresh-water supply system.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Based upon the Recommended Guidelines for Safety Inspection of Dams, Munson Dam is of intermediate size and is placed in the low hazard category. A 100-year frequency event was selected as the design storm by the inspecting engineer. Inflow to the reservoir was calculated using precipitation data from Technical Paper 40 and NOAA TM NWS Hydro 35 by the HEC-1 computer program, which yielded a peak inflow of 5,680 cfs. Discharge is jointly controlled by both the Munson Dam and Brown Dam (NJ 00117). The discharge capacity used in the routing computation was the combined values for the two dams. However, it was assumed that the timber flashboards in the spillway at Brown Dam were closed for the following evaluation. Routing reduced the peak inflow to 1,390 cfs, while the combined spillway capacities before overtopping of either dam occurs is approximately 2,030 cfs. Thus, the design storm is adequately accommodated, with a freeboard of approximately 2.2 feet.

b. Experience Data

There are no streamflow records available for the Salem River and there is no known instance that the dam has been overtopped in the past. There is a tidal gaging station downstream for the Delaware River which has recorded tidal fluctuation of between 5 to 8 feet with a maximum recorded height of +8.5 in 1950. It is reported that hurricane Hazel (in 1954) reached a crest of El. 11 at Brown Dam.

c. Visual Observations

It was noted by the inspection team that considerable portions of the surrounding plant and residential areas in Deepwater and sections of the canal embankment are at or slightly below the top of dam elevation. Hence, any flooding which approached this

design storm crest would be spilling over into large areas of the surrounding terrain. The topography of the entire immediate area is extremely flat (as evidenced by the ratio of storage areas between the normal and flood pool capacities).

d. Overtopping Potential

As there are no records of the dam being overtopped by upland flooding and the fact that the spillway can accommodate the design flood, there is little potential for overtopping. The top of Brown Dam is 0.5 foot higher than Munson Dam reflecting its more exposed position to open seas storm and wind conditions from the south.

e. Drawdown Potential

Drawdown of the reservoir can only be accomplished at Munson Dam as the Brown Dam has no low-water gates. Due to the continual large variations in the tidal tailwater conditions, no meaningful estimate of time can be made.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION

a. Visual Observations

Although the main structural elements are 45 years old, Munson Dam is in a good to excellent overall condition reflecting the continued high caliber of maintenance it receives. The interlocked steel sheeting remains in true alignment and the exposed surfaces show little evidences of excessive oxidation (indicating a good grade of marine structural steel). The concrete within the gated section appears to be in satisfactory condition although only the upper portions are visible. The dam abutments are substantially keyed into the man-made channel banks and are well protected by steel sheeting. The superstructure walkways, ramps and railings are well-maintained, painted and in good alignment.

b. Design and Construction Data

The available design plans furnished by Dupont indicate the major details of construction. It is unknown exactly what earlier construction existed at the site but this is unimportant as all major structural elements in the foundation cofferdam were installed in the 1933 rebuilding of the present substructure. No design information was available regarding assumptions made or allowable stresses employed. However, a cursory review of the structural system indicates that it is very conservatively designed, especially in view of the limited scour potential on the upstream face and the low height to width ratio. The H-piling and sheeting system is driven into stratified alluvial material of the Cape May, Pennsuaken and Bridgeton formations of silts and sands underlaid by deeper marine deposits. From records of the adjacent Delaware River Bridge crossing, the depth to rock is judged to be greater than 120 feet in the vicinity of the dam.

c. Operating Records

The dam has performed satisfactorily under all conditions since its installation and there is little basis to question the conservatism of the original design. Stability conditions and stresses in the cofferdam system are not critical under the most adverse conditions encountered. As previously stated, the Chamber Works Engineering Department maintains close supervision of the dam and has complete operating records.

d. Post Construction Changes

There have been numerous modifications to the operational facilities (gate replacement, catway reconstruction etc.) but none affect the overall structural safety of the dam under the context of this inspection report.

e. Seismic Stability

The dam is located in Seismic Zone 1 and due to this and its low height, has negligible potential vulnerability to seismic loadings. Experience indicates dams in Zone 1 will have adequate stability under dynamic loading conditions if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ PROPOSED REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Munson Dam is assessed to be in an adequate structural and hydraulic condition. The combined spillway capacities of this dam and Brown Dam can accommodate a 100-year frequency design flood and there is little likelihood that the dam could be endangered by overtopping from upland flows. There is minimal downstream hazard should the spillway structure collapse and consequently, the dam is recommended to be downgraded to a low hazard category. No detrimental findings were revealed in this inspection to render a questionable judgement as to the good overall condition of the dam.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the safe operation and structural stability of the dam.

c. Urgency

No urgency is attached to the findings of this report.

d. Necessity for Further Study

Additional inspections are believed to be unnecessary as the dam does not constitute a hazard to human life or a danger to downstream property.

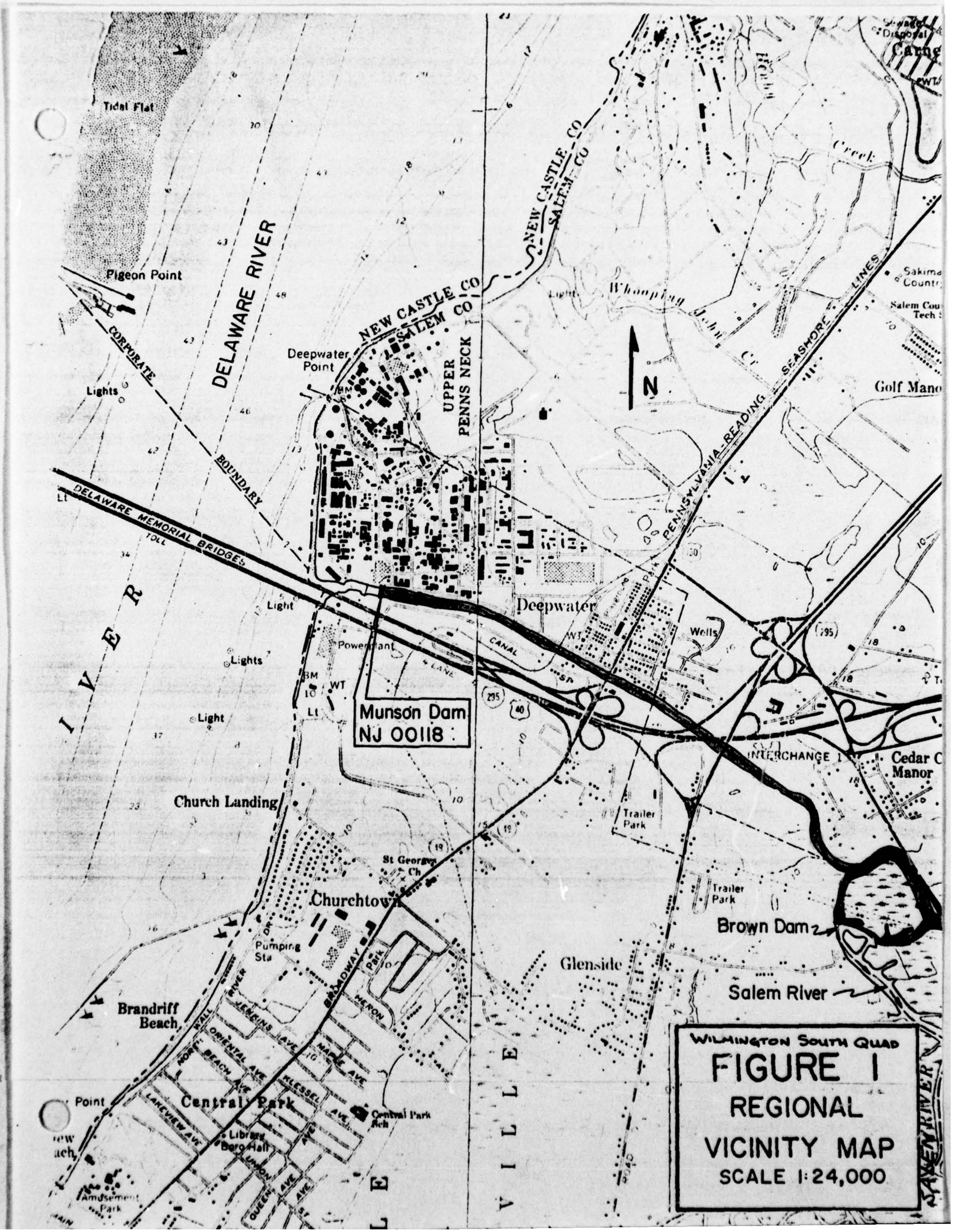
7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives

None are envisioned in the way of recommendations or remedial measures.

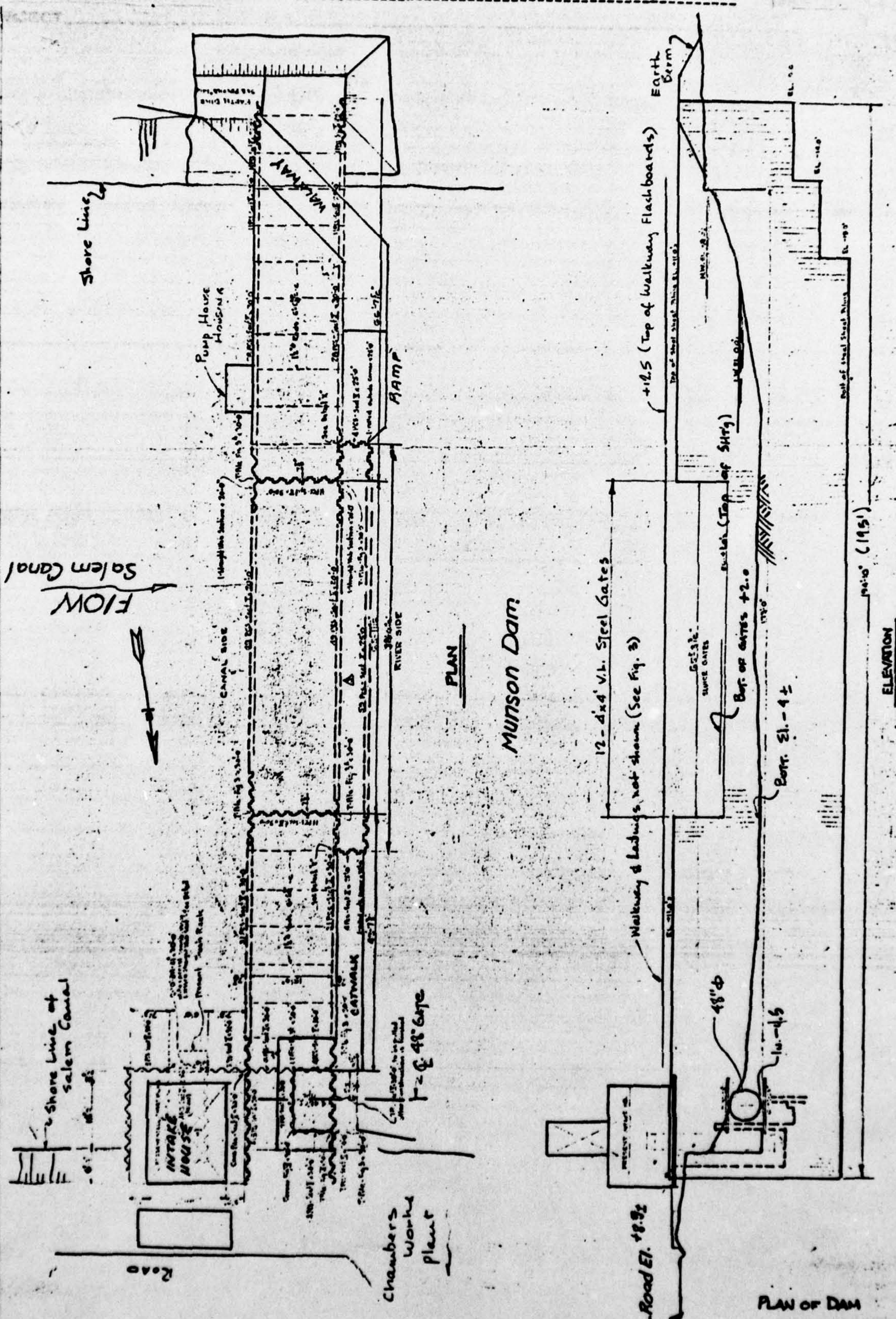
b. O&M Maintenance and Procedures

No additional procedures other than those currently in effect appear to be warranted in light of the above assessment.



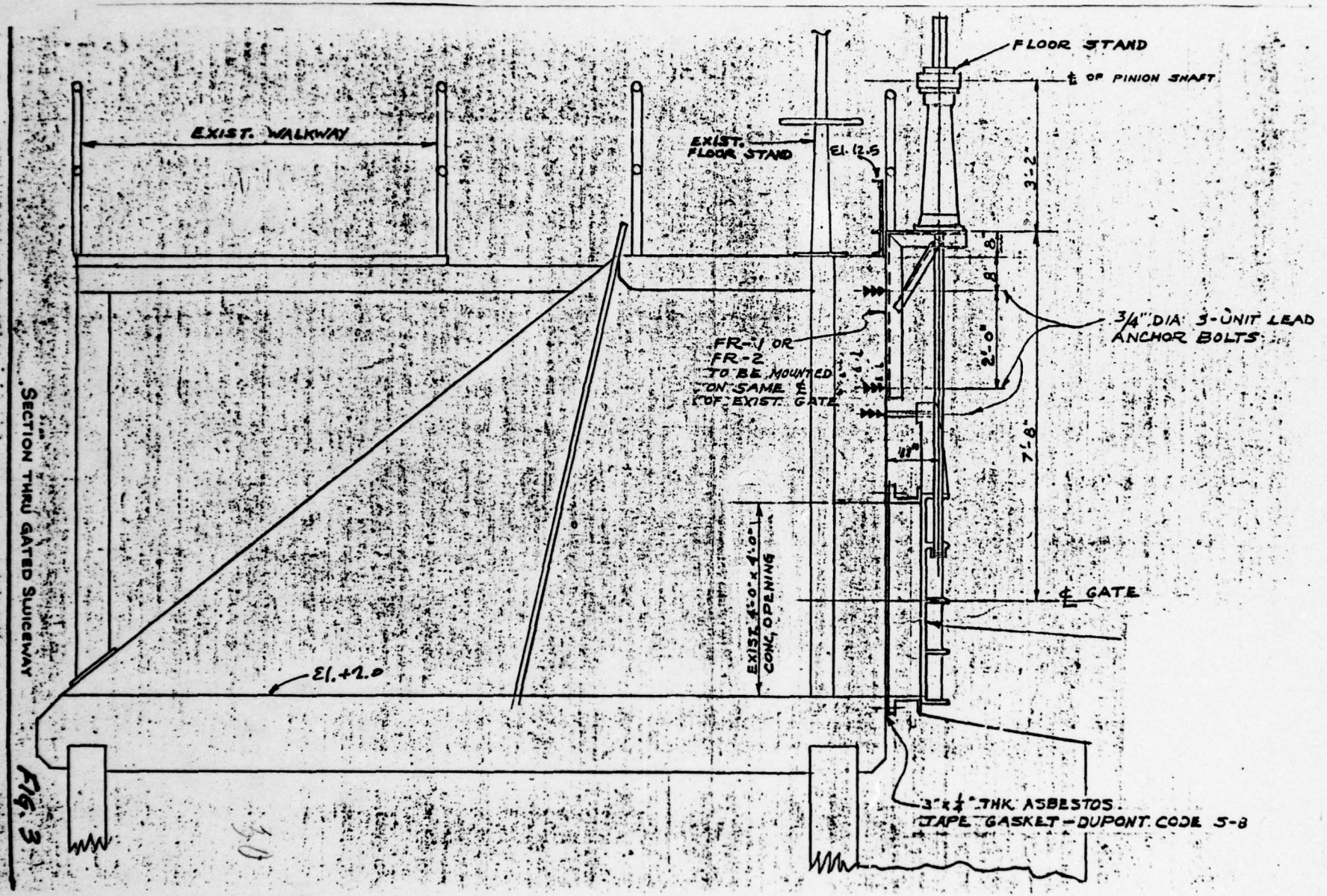
WILMINGTON SOUTH QUAD
FIGURE I
REGIONAL
VICINITY MAP
SCALE 1:24,000
Munson Dam
NJ 00118
Brown Dam
Salem River
DELAWARE RIVER
DELAWARE MEMORIAL BRIDGES
CORPORATE BOUNDARY
NEW CASTLE CO
SALEM CO
UPPER PENNS NECK
PENNSYLVANIA-READING SEASHORE LINES
Tidal Flat
Pigeon Point
Deepwater Point
Deepwater
Power Plant
Church Landing
Churchtown
Glenside
Brandriff Beach
Central Park
Trailer Park
INTERCHANGE 1
Golf Manor
Cedar Manor
Whooping John Creek
Pumping Sta
Amusement Park

LOUIS BERGER & ASSOCIATES INC.



PLAN OF DAM

FIG. 2



SECTION THRU GATED SLUICEWAY

Fig. 3

Check List
Visual Inspection
Phase 1

Name Dam Munson County Salem State New Jersey Coordinators NJDEP

Date(s) Inspection 1/10/79 2/22/79 Weather Clear Temperature 40°

Pool Elevation at Time of Inspection + 4.5 M.S.L. Tailwater at Time of Inspection + 4.0 M.S.L.

Inspection Personnel:

K. Jolls J. Bowers (Dupont)

R. Lang

E. Simone

K. Jolls Recorder

Dam No. 00118

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
		General: Design plans dated 1933. Walkway repaired 1945. Dupont dam I.D. No. 735
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Satisfactory	Transverse steel sheeting at each abutment (limits unknown).
DRAINS	None	
WATER PASSAGES	None	
FOUNDATION	Steel sheeting (see plans)	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING	No major cracking observed.	Most of concrete work supported on steel framework.
VERTICAL AND HORIZONTAL ALIGNMENT	Satisfactory	Walkway elevation raised to 12.5 (1950)
MONOLITH JOINTS	Satisfactory	
CONSTRUCTION JOINTS	Satisfactory	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	N/A	Canal embankment not part of dam.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N/A	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	N/A	
RIPRAP FAILURES	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Satisfactory	
ANY NOTICEABLE SEEPAGE	No	
STAFF GAGE AND RECORDER	None observed	
DRAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Minor cracking observed.	
INTAKE STRUCTURE	Satisfactory	
OUTLET STRUCTURE	Satisfactory	
OUTLET CHANNEL	Canal - same dimensions as upstream.	
EMERGENCY GATE	Operating gates act as emergency gates.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	N/A	Entire 195' structure (top @ El. +12.5) acts as weir if overtopped.
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Satisfactory according to Dupont engineers.	Continuously submerged.
APPROACH CHANNEL	Dug channel of Salem Canal.	Extends upstream to Salem River (approximately 1.8 miles)
DISCHARGE CHANNEL	Salem Canal	Only short distance to main channel of Delaware River. (1000'±)
BRIDGE AND PIERS	Steel superstructure over all operating gates.	
GATES AND OPERATION EQUIPMENT	12 - 4' x 4' Chapman Sluicegates (invert +2)	See Dupont plans for details.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None observed	Dupont has bench marks and staff gage recorders. Maintains constant records of water elevations.
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	USGS tidal gage at Delaware Memorial Bridge Supension Tower.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Made-man canal. Most edges protected with bulkhead and/or seawall.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Short tidal channel few hundred feet to Delaware River.	No obstructions
SLOPES	Sides protected by seawall.	
APPROXIMATE NO. OF HOMES AND POPULATION	None	

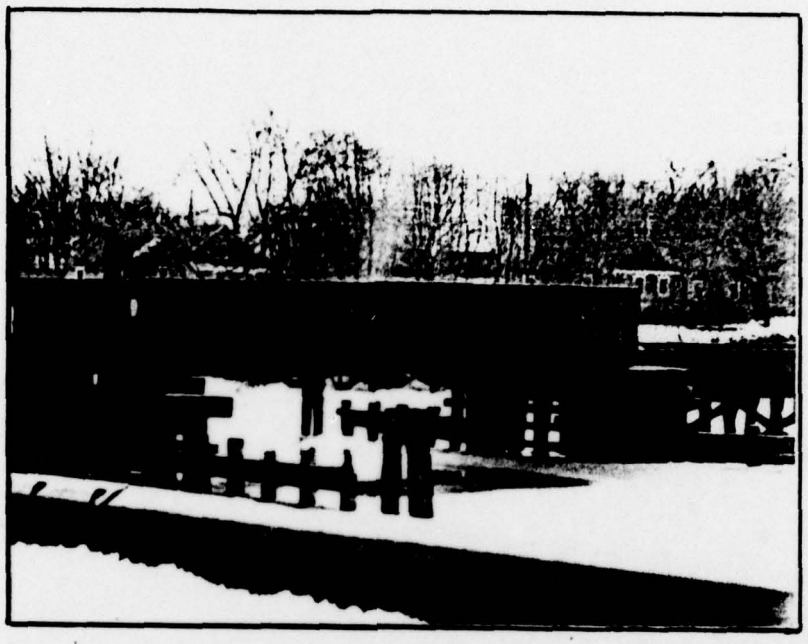
CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available * (from Dupont Chambers Works, Deepwater, N.J.)
REGIONAL VICINITY MAP	Quad Sheet
CONSTRUCTION HISTORY	Available *
TYPICAL SECTIONS OF DAM	Available *
HYDROLOGIC/HYDRAULIC DATA	Not available
OUTLETS - PLAN - DETAILS -CONSTRAINTS -DISCHARGE RATINGS	None
RAINFALL/RESERVOIR RECORDS	None

ITEM	REMARKS
SPILLWAY PLAN	Dupont plans for dam structure.
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Dupont plans for dam structure.

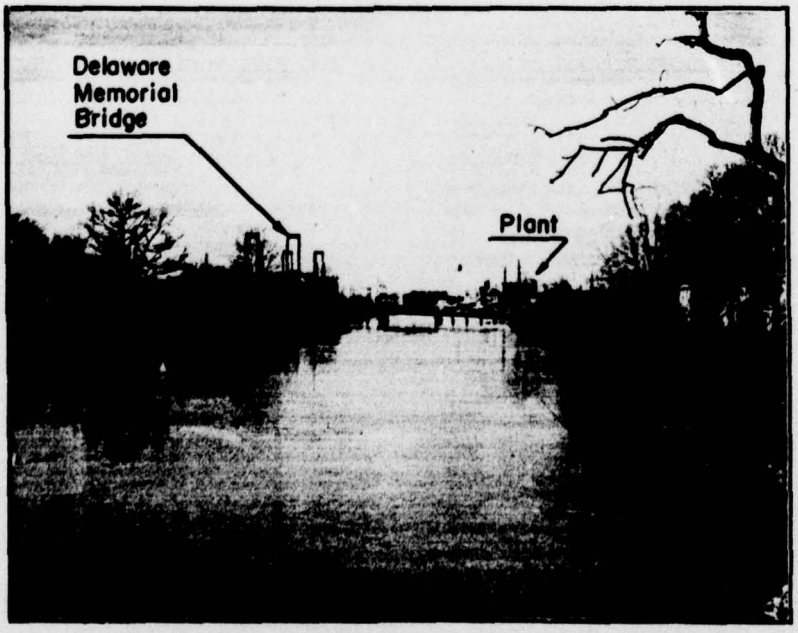
ITEM	REMARKS
DESIGN REPORTS	Not available
GEOLOGY REPORTS	N/A
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	N/A
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	N/A
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES.	Not applicable

ITEM	REMARKS
MONITORING SYSTEMS	Dupont details
MODIFICATIONS	Numerous (available from Dupont)
HIGH POOL RECORDS	N/A
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	N/A
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None available



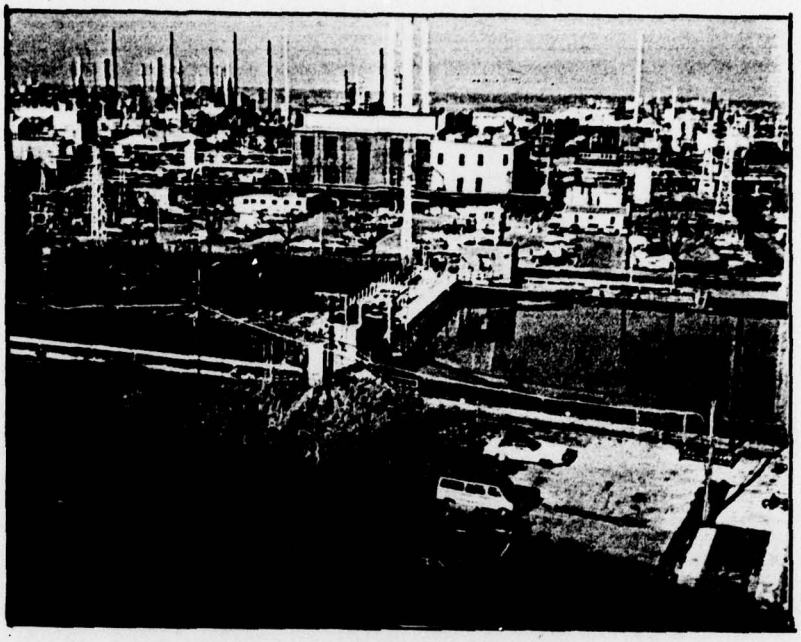
Upstream R.R. bridge over Salem Canal

February 1979



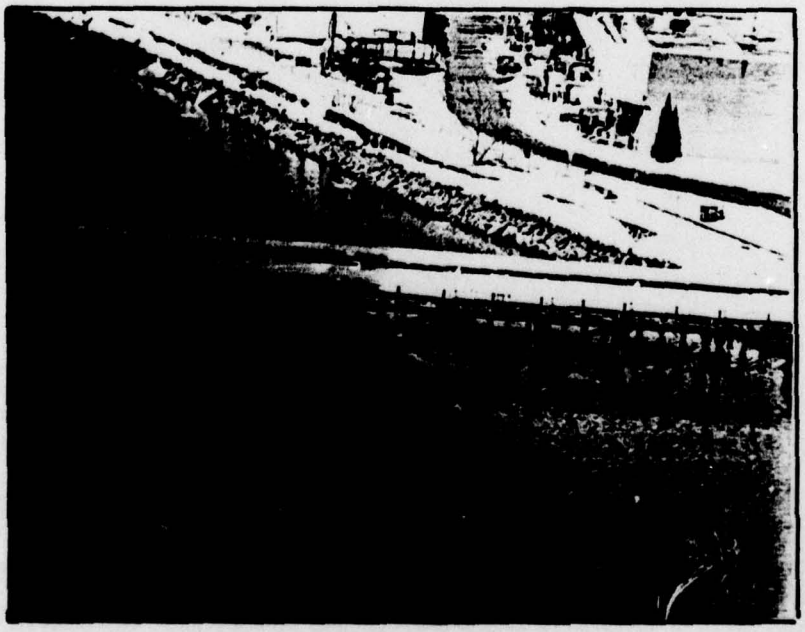
View West along canal towards Chambers Works Plant

January 1979



View of Munson Dam from Delaware Memorial Br.

January 1979



Pipe crossing downstream of dam

February 1979

Dam No. 00118

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 60 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): + 4.3 (1100 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): +12.5 (19460 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: + 4.8

ELEVATION TOP DAM: + 12.5 (concrete walk)

CREST:

a. Elevation +12.5
b. Type Broad-crested weir
c. Width 17'
d. Length 195'
e. Location Spillover Entire dam crest
f. Number and Type of Gates

OUTLET WORKS: 12 sluicegates

a. Type 4 x 4 vertical lift sluicegates
b. Location Center of dam
c. Entrance inverts + 2.0
d. Exit inverts + 2.0
e. Emergency draindown facilities 1-48" ø sluiceway (-4.5 invert)

HYDROMETEOROLOGICAL GAGES: None at dam

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 2030 CFS (gate capacity)

BY RGL DATE Feb '79 | LOUIS BERGER & ASSOCIATES INC. | SHEET NO. A1 OF
CHKD. BY DATE | Munson & Brown Dams | PROJECT C226
SUBJECT

Snyder Coefficients (from Corps)

$C_T = 4.51$
$C_p = 0.70$

Drainage Area = 60.0 sq. mi.

Length of longest watercourse = 15.80 mi

Length along watercourse to centroid = 8.90 mi.

$\therefore t_p = 4.51(15.8 \times 8.90)^{0.3}$

$= 19.89$ hours

The following calculations are based on the fact that Munson & Brown Dams impound the same lake. Moreover the spillway gates at Brown Dam are assumed to be closed under flood conditions

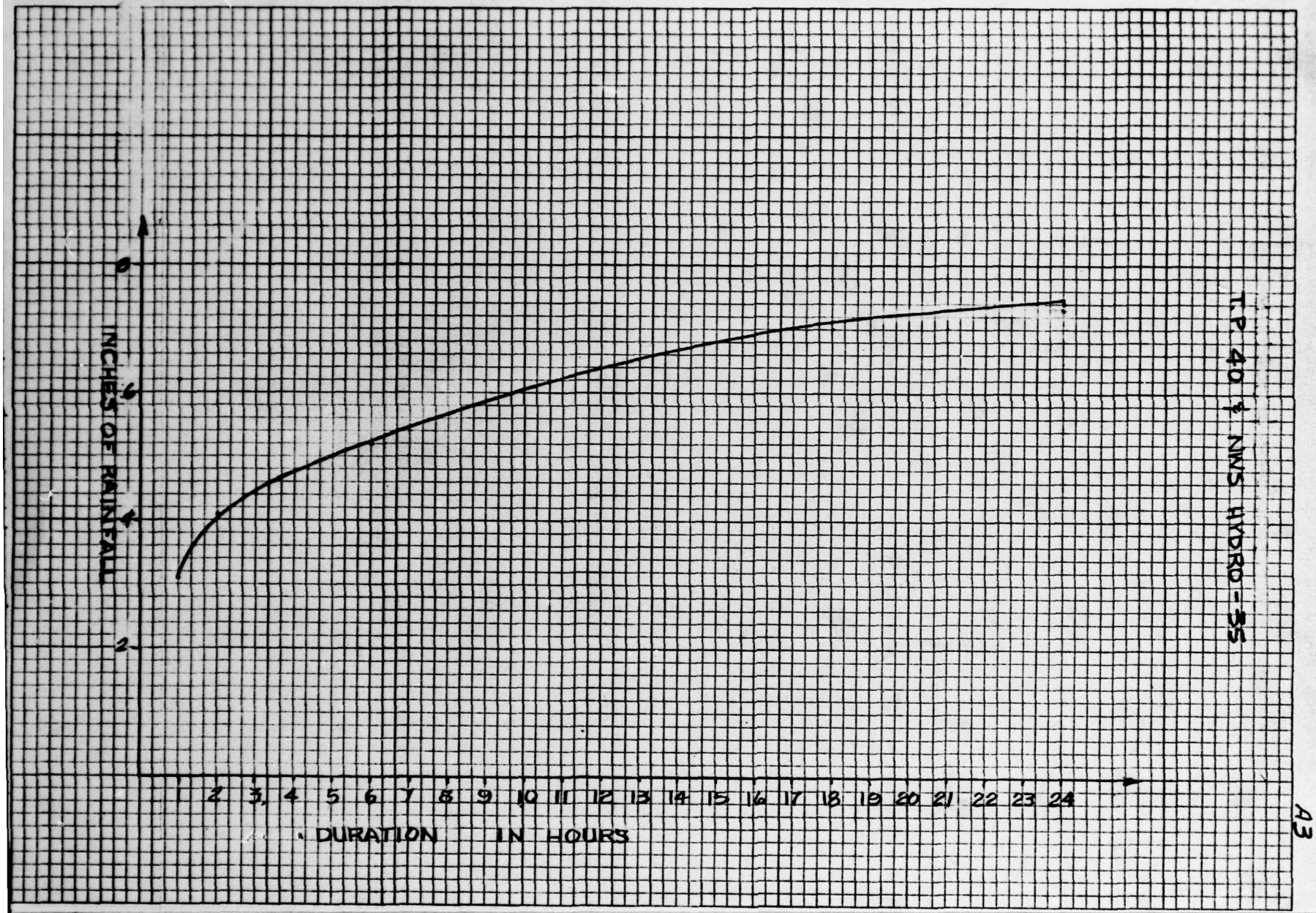
BY RGL DATE Mar '79 LOUIS BERGER & ASSOCIATES INC. SHEET NO. A2 OF
CHKD. BY DATE Munson & Brown Dam PROJECT C226
SUBJECT

Precipitation data from TP-40 and NOAA Technical Memo NWS-Hydro 35

Time	Precip	Δ	Rearrange
1	3.10	3.10	0.05
2	4.00	1.10	0.05
3	4.40	0.40	0.10
4	4.71	0.31	0.10
5	4.96	0.25	0.10
6	5.20	0.20	0.15
7	5.40	0.20	0.20
8	5.60	0.20	0.20
9	5.80	0.20	0.20
10	6.00	0.20	0.31
11	6.20	0.20	1.1
12	6.40	0.20	3.10
13	6.55	0.15	0.4
14	6.70	0.15	0.25
15	6.80	0.10	0.20
16	6.90	0.10	0.20
17	7.00	0.10	0.20
18	7.10	0.10	0.20
19	7.20	0.10	0.15
20	7.25	0.05	0.10
21	7.30	0.05	0.10
22	7.35	0.05	0.05
23	7.40	0.05	0.05
24	7.45	0.05	0.05

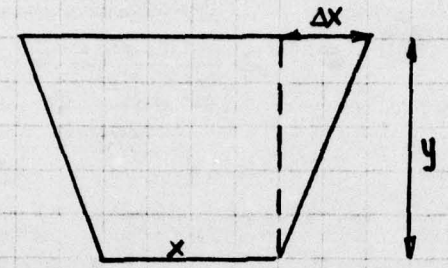
SD

46 0706



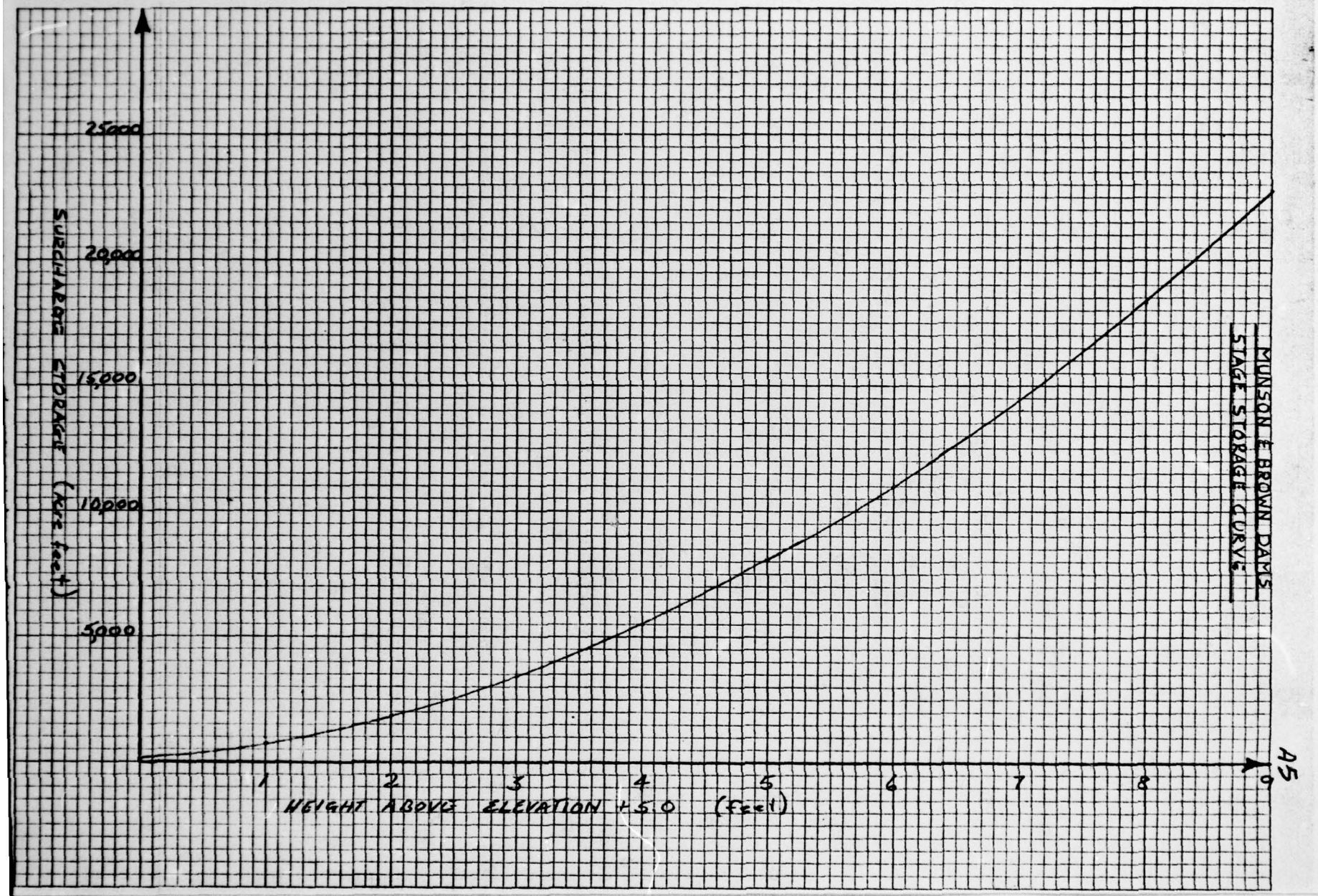
BY RGL DATE Feb '79 LOUIS BERGER & ASSOCIATES INC. SHEET NO. A4 OF
CHKD. BY DATE Munson & Brown Dams PROJECT C 226
SUBJECT Storage

Area at elev. +4.5 = 171 acres
Area at elev. +10.0 = 2745 acres



Increment in vol. $\Delta V = (x+\Delta x)y$

Height above sea level	Surcharge storage
0	0
2	0
4	0
4.5	0
5	144
6	783
7	1890
8	3465
9	5508
10	8019
11	10998
12	14445
13	18360
14	22743
15	27594



A5

BY RGL DATE FEB '79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF
CHKD. BY DATE MUNSON & BROWN DAMS PROJECT C226
SUBJECT DISCHARGE

Munson:

1-48"ϕ sluicegate
$A = 12.57\ ft^2$ $C = 0.62$
Inv. El. = -4.50

12-4'x4' sluicegates
$A = 192\ ft^2$ $C = 0.62$
Inv. El. = +2.0

Assume tailwater at elev. +8.5

Elev.	H	Q		H	Q
8.50	0	0		0	0
9.00	0.50	44		0.5	675
10.00	1.50	77		1.5	1170
11.00	2.50	99		2.5	1510
12.00	3.50	117	TOP OF DAM	3.5	1787
13.0	4.50	133		4.5	2026
14.0	5.50	147		5.5	2240
15.0	6.50	159		6.5	2436

over dam $L = 150$ $C = 2.8$

13.0	0.5	148
14.0	1.5	772
15.0	2.5	1660

Brown:

Since the gates at Brown Dam are normally closed, they are assumed closed for discharge calculation::
$L = 2225.5'$ (including flow over flashboards)
Top of Dam

Elev.	H	Q
14.0	1.0	6454
15.0	2.0	18255

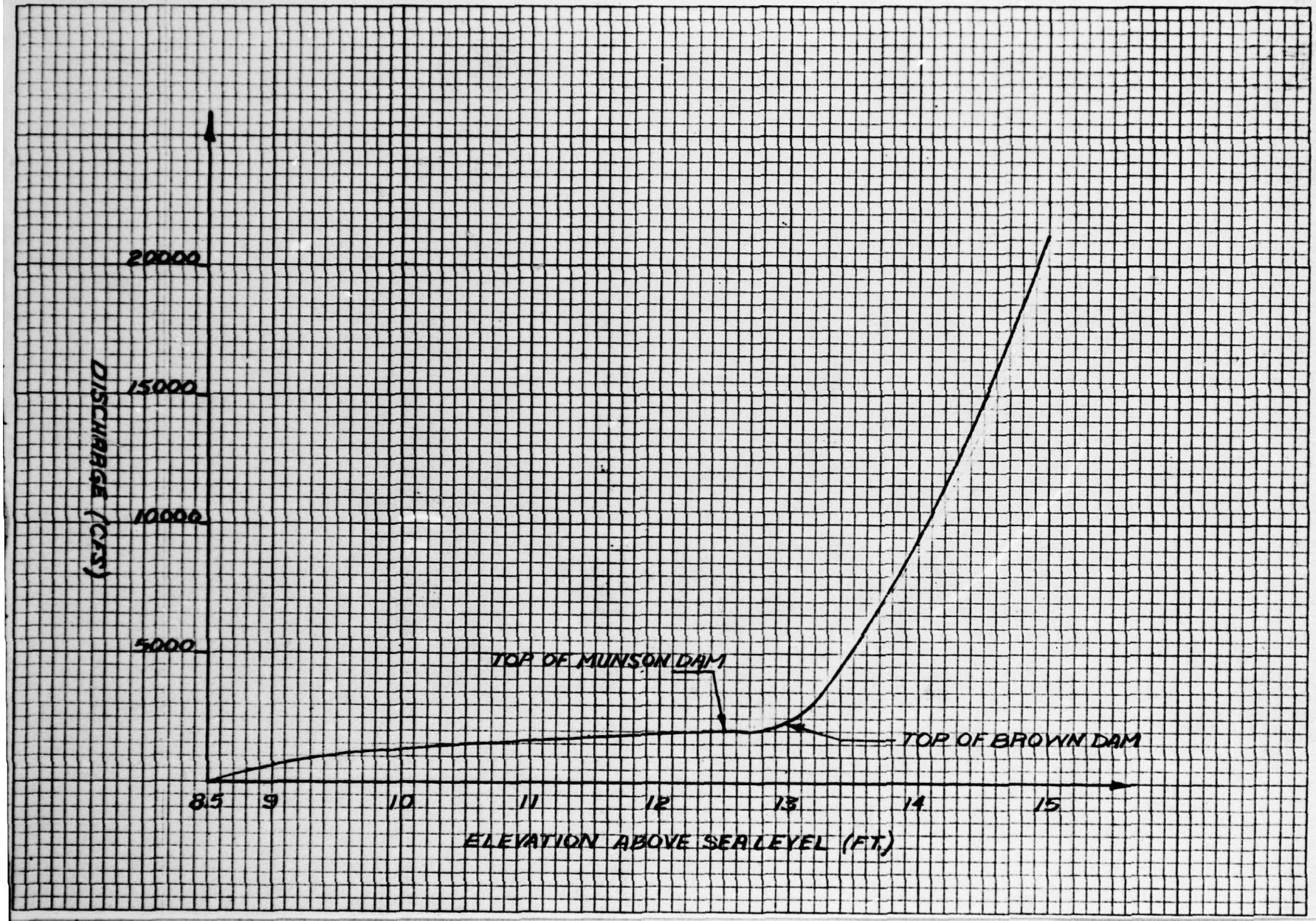
BY RGL DATE Feb '79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A7 OF
CHKD. BY DATE Munson & Brown Dams PROJECT 6226
SUBJECT Combined Discharges

assuming tailwater of +8.5

Elev.	Q
8.50	0
9.0	719
10.0	1247
11.0	1609
12.0	1904
13.0	2307
14.0	9613
15.0	22510

Summary of discharge & storage data

Elev.	Storage	Discharge
8.5	4487	0
9	5508	719
10	8019	1247
11	10998	1609
12	14445	1904
12.5	16403	2032
13	18360	2307
13.5	20552	5015
14	22743	9613
15	27594	22510



BY D.J.M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A9 OF

CHKD. BY _____ DATE _____ MUNSON DAM INSPECTION PROJECT 6226

SUBJECT _____

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	2	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
67	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	1	60.00	0.0	60.00	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
24	0.0	0.0	0.0

PRECIP PATTERN

0.05	0.05	0.10	0.10	0.10	0.15	0.20	0.20	0.20	0.31
1.10	3.10	0.40	0.25	0.20	0.20	0.20	0.20	0.15	0.10
0.10	0.05	0.05	0.05						

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA

TP= 19.90 CP=0.70 NTA= 0

RECESSION DATA

STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=11.41 AND R= 7.52 INTERVALS

UNIT HYDROGRAPH 47 END-OF-PERIOD ORDINATES, LAG= 19.96 HOURS, CP= 0.69 VOL= 1.00

44.	164.	329.	517.	717.	923.	1109.	1249.	1337.	1375.
1358.	1263.	1117.	978.	856.	749.	656.	574.	503.	440.
385.	337.	295.	258.	226.	198.	173.	152.	133.	116.
102.	89.	78.	68.	60.	52.	46.	40.	35.	31.
27.	24.	21.	18.	16.	14.	12.			

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COFF Q
1	0.05	0.00	0.
2	0.05	0.00	0.
3	0.10	0.00	0.

BY D.J.M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A10 OF

CHKD. BY ____ DATE ____ MUNSON DAM INSPECTION PROJECT C226

SUBJECT ____

4	0.10	0.00	0.
5	0.10	0.00	0.
6	0.15	0.00	0.
7	0.20	0.00	0.
8	0.20	0.00	0.
9	0.20	0.00	0.
10	0.31	0.11	5.
11	1.10	0.90	58.
12	3.10	2.90	312.
13	0.40	0.20	837.
14	0.25	0.05	1533.
15	0.20	0.00	2319.
16	0.20	0.00	3151.
17	0.20	0.00	3980.
18	0.20	0.00	4707.
19	0.15	0.00	5244.
20	0.10	0.00	5571.
21	0.10	0.00	5679.
22	0.05	0.00	5539.
23	0.05	0.00	5116.
24	0.05	0.00	4535.
25	0.0	0.0	3976.
26	0.0	0.0	3481.
27	0.0	0.0	3047.
28	0.0	0.0	2668.
29	0.0	0.0	2335.
30	0.0	0.0	2044.
31	0.0	0.0	1789.
32	0.0	0.0	1566.
33	0.0	0.0	1371.
34	0.0	0.0	1200.
35	0.0	0.0	1051.
36	0.0	0.0	920.
37	0.0	0.0	805.
38	0.0	0.0	705.
39	0.0	0.0	617.
40	0.0	0.0	540.
41	0.0	0.0	473.
42	0.0	0.0	414.
43	0.0	0.0	362.
44	0.0	0.0	317.
45	0.0	0.0	278.
46	0.0	0.0	243.
47	0.0	0.0	213.
48	0.0	0.0	186.
49	0.0	0.0	163.
50	0.0	0.0	143.
51	0.0	0.0	125.
52	0.0	0.0	109.
53	0.0	0.0	96.
54	0.0	0.0	84.
55	0.0	0.0	73.
56	0.0	0.0	64.
57	0.0	0.0	55.
58	0.0	0.0	39.
59	0.0	0.0	3.
60	0.0	0.0	1.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.
72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
101	0.0	0.0	0.
102	0.0	0.0	0.
103	0.0	0.0	0.
104	0.0	0.0	0.
105	0.0	0.0	0.
106	0.0	0.0	0.
107	0.0	0.0	0.
108	0.0	0.0	0.
109	0.0	0.0	0.
110	0.0	0.0	0.
111	0.0	0.0	0.
112	0.0	0.0	0.
113	0.0	0.0	0.
114	0.0	0.0	0.
115	0.0	0.0	0.
116	0.0	0.0	0.
117	0.0	0.0	0.
118	0.0	0.0	0.
119	0.0	0.0	0.
120	0.0	0.0	0.
121	0.0	0.0	0.
122	0.0	0.0	0.
123	0.0	0.0	0.
124	0.0	0.0	0.
125	0.0	0.0	0.

BY D.J.M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A11 OF

CHKD. BY ______ DATE ______ MONSON DAM INSPECTION PROJECT C226

SUBJECT ______

126	0.0	0.0	0.
127	0.0	0.0	0.
128	0.0	0.0	0.
129	0.0	0.0	0.
130	0.0	0.0	0.
131	0.0	0.0	0.
132	0.0	0.0	0.
133	0.0	0.0	0.
134	0.0	0.0	0.
135	0.0	0.0	0.
136	0.0	0.0	0.
137	0.0	0.0	0.
138	0.0	0.0	0.
139	0.0	0.0	0.
140	0.0	0.0	0.
141	0.0	0.0	0.
142	0.0	0.0	0.
143	0.0	0.0	0.
144	0.0	0.0	0.
145	0.0	0.0	0.
146	0.0	0.0	0.
147	0.0	0.0	0.
148	0.0	0.0	0.
149	0.0	0.0	0.
150	0.0	0.0	0.
SUM	7.61	4.16	80142.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5679.	5596.	4502.	2193.	80141.
INCHES		0.87	2.79	4.08	4.14
AC-FT		2777.	8935.	13054.	13253.

HYDROGRAPH ROUTING

ROUTING THROUGH RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
67	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	4487.	5508.	8019.	10998.	14445.	16403.	18360.	20552.	22743.	27594.
OUTFLOW=	0.	719.	1247.	1609.	1904.	2032.	2307.	5015.	9613.	22510.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.
6	0.	0.	0.
7	0.	0.	0.
8	0.	0.	0.

BY D.J.M. DATE 4-71 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A12 OF...

CHKD. BY..... DATE..... MUNSON DAM INSPECTION PROJECT C226

SUBJECT.....

9	0.	0.	0.
10	0.	2.	0.
11	6.	31.	0.
12	36.	185.	0.
13	131.	574.	0.
14	327.	1185.	0.
15	645.	1926.	0.
16	1097.	2735.	0.
17	1687.	3566.	0.
18	2405.	4344.	0.
19	3227.	4976.	0.
20	4121.	5407.	0.
21	5020.	5625.	375.
22	5850.	5609.	791.
23	6587.	5328.	946.
24	7218.	4826.	1079.
25	7734.	4255.	1187.
26	8148.	3729.	1263.
27	8475.	3264.	1302.
28	8730.	2857.	1333.
29	8921.	2501.	1357.
30	9057.	2190.	1373.
31	9146.	1917.	1384.
32	9194.	1678.	1390.
33	9207.	1469.	1391.
34	9190.	1286.	1389.
35	9147.	1126.	1384.
36	9081.	985.	1376.
37	8997.	862.	1366.
38	8897.	755.	1354.
39	8784.	661.	1340.
40	8659.	579.	1325.
41	8525.	506.	1309.
42	8384.	443.	1291.
43	8236.	388.	1273.
44	8083.	340.	1255.
45	7927.	297.	1228.
46	7770.	260.	1195.
47	7613.	228.	1162.
48	7457.	199.	1129.
49	7302.	175.	1096.
50	7148.	153.	1064.
51	6997.	134.	1032.
52	6849.	117.	1001.
53	6703.	103.	970.
54	6560.	90.	940.
55	6420.	79.	911.
56	6283.	69.	882.
57	6149.	60.	854.
58	6018.	47.	826.
59	5887.	21.	799.
60	5758.	2.	772.
61	5633.	0.	745.
62	5512.	0.	720.
63	5399.	0.	642.
64	5299.	0.	572.
65	5209.	0.	509.
66	5130.	0.	453.
67	5059.	0.	403.
68	4996.	0.	359.
69	4940.	0.	319.
70	4890.	0.	284.
71	4846.	0.	253.
72	4807.	0.	225.
73	4771.	0.	200.
74	4740.	0.	178.
75	4712.	0.	159.
76	4687.	0.	141.
77	4665.	0.	126.
78	4646.	0.	112.
79	4628.	0.	100.
80	4613.	0.	89.
81	4599.	0.	79.
82	4587.	0.	70.
83	4576.	0.	62.
84	4566.	0.	56.
85	4557.	0.	49.
86	4550.	0.	44.
87	4543.	0.	39.
88	4537.	0.	35.
89	4531.	0.	31.
90	4526.	0.	28.
91	4522.	0.	25.
92	4518.	0.	22.
93	4515.	0.	19.
94	4512.	0.	17.
95	4509.	0.	15.
96	4506.	0.	14.
97	4504.	0.	12.
98	4502.	0.	11.
99	4501.	0.	10.
100	4499.	0.	9.
101	4498.	0.	8.
102	4497.	0.	7.
103	4496.	0.	6.
104	4495.	0.	5.
105	4494.	0.	5.
106	4493.	0.	4.
107	4492.	0.	4.
108	4492.	0.	3.
109	4491.	0.	3.
110	4491.	0.	3.
111	4490.	0.	2.
112	4490.	0.	2.
113	4490.	0.	2.
114	4489.	0.	2.
115	4489.	0.	1.
116	4489.	0.	1.
117	4489.	0.	1.
118	4488.	0.	1.
119	4488.	0.	1.
120	4488.	0.	1.
121	4488.	0.	1.
122	4488.	0.	1.
123	4488.	0.	1.
124	4488.	0.	1.
125	4488.	0.	0.
126	4488.	0.	0.
127	4488.	0.	0.
128	4487.	0.	0.
129	4487.	0.	0.
130	4487.	0.	0.

131	4487.	0.	0.
132	4487.	0.	0.
133	4487.	0.	0.
134	4487.	0.	0.
135	4487.	0.	0.
136	4487.	0.	0.
137	4487.	0.	0.
138	4487.	0.	0.
139	4487.	0.	0.
140	4487.	0.	0.
141	4487.	0.	0.
142	4487.	0.	0.
143	4487.	0.	0.
144	4487.	0.	0.
145	4487.	0.	0.
146	4487.	0.	0.
147	4487.	0.	0.
148	4487.	0.	0.
149	4487.	0.	0.
150	4487.	0.	0.
SUM			52995.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1391.	1390.	1370.	1193.	52995.
INCHES		0.22	0.85	2.22	2.74
AC-FT		690.	2718.	7104.	8764.

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	67	5679.	5596.	4502.	2193.	60.00
ROUTED TO	67	1391.	1390.	1370.	1193.	60.00